comprise on their shell surface a cylindrical circumferential segment (36) which is separated, if necessary, from the profiled circumferential segments (35, 40) that exhibit a non-cylindrical contour.

36. (Amended) The method as defined in ~~claim 1, in combination with~~ claim 10 ~~11~~ or 25, characterised in that the thickness of the metal strip (16) is reduced during the equalising step by a dimension in the order of one tenth of the thickness.

REMARKS

Careful consideration has been given to the above-identified Official Action, and reconsideration of this application, as amended, is respectfully requested.

Further research is being undertaken regarding detailed statement 2 as to the various German priority documents.

Detailed objection number 5 of the Office Action is noted. It is not understood why there is objection to the term "equalization" since the term is clearly enough identified on page 15, last paragraph through page 17, second paragraph. In particular reference was specifically made to German Patent DE25 41 402 C2 which describes to one of ordinary skill in the art especially as seen in the drawings such equalization. Equalization is explained and is referenced in the above referenced sections of the specification. There is also a British equivalent of the German Patent, namely, GB 1 543 621, a copy of which is transmitted herewith.

Claim 1 has been amended as has claim 3. Claims 11 and 12 have been cancelled. Claims 23, 24 and 26 have been amended to recite that length is lineal length, and thus the detailed objection in paragraph 9 has been addressed regarding claims 23, 24 and 26. Claim 36 has also been amended.

The claims have been rejected under 35 USC 102 as unpatentable either over Parr 224,720 or Nicols 238,953. This rejection is respectfully traversed.

As regards paragraph No. 11 of the detailed office action, it is to be noted that Parr discloses rolling blanks into chisels. The known Parr method does not disclose a recalling in the sense of the present application. In the first step of Parr, the blank is introduced into the gap between the upper roll C and the lower roll D while the upper roll faces the lower roll with its small diameter section. Consequently, during the step of

insertion no rolling operation occurs. The next step is shown in Figure 2 of the Parr reference. The upper roll engages the inserted blank by its larger diameter section G and moves the blank out of the gap between the two rolls (Figure 3) while at the same time forming the chisel into its final shape (page 2, lines 7 to 18). In a further step the chisel is again placed into the gap between the two rolls, however not in the same orientation, but turned by 90 degrees on its edge. Thereafter the edges are rolled in a single step as shown in Figures 4 and 5, see also page 2, lines 22 to 32.

Thus, Parr discloses rolling the blanks in both of their possible orientations (on the flat side and on edge) continuously in a single step. In contrast to this, the present invention teaches to roll a stip-like-pre-material discontinuously in successive steps by rolling a specific section of the strip, recalling the strip and rolling the same section in the same orientation (strip material can not be rolled on edge) at least once again before moving it to a subsequent section and rolling the subsequent section in a first step, recalling the strip and rolling the subsequent section at least once again etc. etc. In this way the strip-like-material which can be wound and unwound by coilers, is not rolled continuously from the beginning to the end of the strip-material but discontinuously by dividing the material in a series of sections, each of which is rolled at least twice before a subsequent section is rolled at least twice. Nothing like that is disclosed or suggested by Parr.

Claim 1 has been amended to specifically overcome the Parr reference and will be seen to overcome the Nicols reference discussed below. In particular, claim 1 has been amended to specifically recite the steps involved in producing a strip-like pre-material such that the metal strip is divided into a series of sections, each of which is rolled at least twice before a subsequent section is rolled. This sectioning of the metal strip in conjunction with the rolling and recalling of the strip is neither found, suggested nor disclosed in Parr or in any of the prior art, and is the subject of claim 1 as now amended.

Since claim 1 is believed patentable then dependent claims 2, 3, 4, 33, 39, 40 and 41 should also be allowable.

As regards paragraph No. 13 of the detailed office action, it is to be noted that Nicols does not disclose the rolling of strip-like-material but the rolling of blanks for

twist-drills. Such a blank is disclosed to be rolled in a number of passes between oscillating rolls, however, Nicols does not disclose to divide a strip into a series of sections and to roll any specific section at least twice before proceeding to roll a subsequent section in the series of sections likewise at least twice.

As regards No. 16 of the detailed action it is to be noted that the method disclosed by Richardson is rather similar to the method disclosed by Parr. A blank for making axles is inserted into the gap between two rollers while the two rollers are facing each other with their smaller diameter section and thereafter the rotating rolls engage the blank and roll it continuously until the end thereof is released from the rolling gap (see Figure 3). Again it is not disclosed to divide the blanks (which are not in the form of strips) in a series of sections (each of which is according to the present invention rolled at least twice before the next section is rolled at least twice).

As regards No. 20 of the detailed action it is to be noted that Nicols and likewise Richardson as well as Parr do not disclose the manufacture of a strip-like pre-material from which coins and medals could be punched.

As regards Nos. 21 to 26 of the detailed action dealing with the Ginazburg reference it is to be noted that Ginsburg does not teach producing a strip having a profile rolled into a series of sections of the strip. The reason why Ginzburg rolls a strip-like material repeatedly is that the pre-material which is rolled is provided by a continuously operated casting apparatus which delivers the pre-material at a lower speed than the operation speed of the rolling machine. So the rolling machine can not be operated continuously like the casting apparatus but is controlled to reduce the thickness of the blank discontinuously in successive steps so that the operation speed of the rolling machine can be matched to the operation speed (the casting speed) of the casting apparatus. The result is a strip having a uniform thickness along its whole length. In contrast to this it is the object of the present invention as defined in the amended claim 1 to provide a strip-like material which has a recurring profile along its lengths. Nothing like that is taught or suggested by Ginzburg.

The Examiner believes that those skilled in the art could combine the teaching of Ginzburg with the teaching of Nicols. However, Nicols does not teach to produce a continuous strip-like material but to produce short unitary work pieces. In fact, it is technically impossible to combine the teaching by Nicols with the teaching by Ginzburg.

In view of the specific recitation of the section of claim 1 and the dependent claims there related, none of the prior art taken alone or in combination renders the currently pending claims unpatentable.

In view of the above action and comments, an early notice of allowance is solicited.

Respectfully submitted,

Peter L. Berger (Reg. No.24,570)

LEVISOHN, BERGER & LANGSAM, LLP
805 Third Avenue, 19th Floor
New York, New York 10022
(212) 486-7272 (phone)
(212) 486-0323 (fax)

H:\Wanda\1549\1549.004 Amend 10103.wpd

PATENT SPECIFICATION (11) 1 543 621

1 543 621

(21) Application No. 37435/76 (22) Filed 9 Sep. 1976 (19)

(31) Convention Application No. 2541402 (32) Filed 17 Sep. 1975 in

(33) Fed. Rep of Germany (DE)

(44) Complete Specification Published 4 Apr. 1979

(51) INT. CL.² B21B 13/14

(52) Index at Acceptance
B3M 13B 19B 9Q G

(72) Inventor: HANS-JÖRG BAUDER

(54) EQUALISING ROLLING MILL

(71) I, CARL WEZEL, a citizen of the Federal Republic of Germany, of 95 Industriestrasse, D-7130 Mühlacker, West Germany, do hereby declare the invention, for which I pray that a patent may be granted to me, and the method by which it is to be performed, to be particularly described in and by the following statement:–

This invention relates to an equalising rolling mill.

Metal strips of constant gauge are required for many purposes. To this end, metal sheets, which are supplied with gauge tolerances due to manufacture, are equalised, that is, rolled down to a somewhat lesser gauge to a rolling mill with an opening as constant as possible between rolls, whereby the original gauge tolerances are partially evened out. In the production of cartridge cases the starting material has, for example, typically a gauge of 4 mm. and a gauge tolerance of ± 0.05 mm. The rolled material requires a final gauge of 3.6 mm, and a gauge tolerance of ± 0.003 mm.

The gauge and also the hardness of the starting material are not however uniform, so that the forces acting on the roll journals fluctuate during the rolling operation. Due to the clearance or play of the rolls in their bearings the rolls will shift radially in the presence of rolling forces. The rolling forces depend on the hardness of the sheet metal, its reduction in thickness and also on the thickness tolerances of the sheet metal to be rolled. Consequently, the tolerances in thickness and hardness will influence the accuracy of the rolled (equalised) sheet metal.

The problem on which the invention is based is to construct a rolling mill whereof the roll-gap remains uninfluenced by gauge and hardness fluctuations in the starting material.

The present invention is an equalising rolling mill in which roll journals are prestressed in a plane normal to thhe roll axis and in a direction directed on to the roll-gap which direction deviates from the vertical by the rolling angle, i.e. the angle between the direction of the force acting on the working roll during rolling and the vertical direction.

In this way the rolls can no longer give way to the varying force components originating in the tolerances of the starting material, but they remain in their ideal position, so that there is a particular accuracy in running of the individual rolls and therefore also a constant roll-gap even during the rolling procedure. At the same time the additional loading of the roller bearing results from the prestressing is practically negligible because the necessary prestressing forces are much smaller than the normal rolling forces, transmitted on the roller bearings as the original thickness tolerances of the starting material are smaller than its predetermined reduction in thickness (by the rolling process). Preferably, however, the prestressing is set distinctly higher than would be necessary because of the gauge tolerances, for example, twice as high, in order safely to cope with all fluctuations which occur.

In the preferred embodiment of the equalising rolling mill according to the invention, the roll journals are extended outwardly beyond the roll journal bearings. Because of this they provide a suitable point of application for the pre-stressing device. The roll journals are preferably pre-stressed hydraulically. Smaller rollers, however, can also be prestressed mechanically without any difficulty.

An embodiment of the present invention will now be described, by way of example with reference to the accompanying drawings, in which:–

Fig. 1 is a section through an equalising rolling mill with representation of a force diagram;

Fig. 2 is a front elevation of the rolling mill;

Fig. 3 is a side elevation of the rolling mill, and

Fig. 4 is a representation of the rolling mill for determination of the rolling angle α.

The equalising rolling mill has rolls 2, 2' which are supported in blocks 6, 6' through rollers 5, 5'. Starting material 3 is provided from roll stock and has a nominal gauge S, but this fluctuates between the nominal gauge S and the gauge S + T.

There is a play of about 0.09 and 0.13 mm between the outer race 7, 7' of the roller bearing and the roller body: in fact, in the state of rest (because of the weight of the rolls) the play is at the roll-gap-remote side in the case of the upper roll 2, and at the roll-gap-adjacent side in the case of the lower roll 2'. In operation the upper roll is lifted by the roll stock 3, the play thus also being shifted to the roll-gap-adjacent side. The lower roll on the other hand remains in its normal position.

From the starting material 3 of gauge S a strip 4 of the gauge S_E is produced as the final material.

The actual gauge of the starting material 3 is between the nominal gauge S and a gauge S + T. The gauge S produces in the outer race 7 a rolling pressure force $\vec{p}$, which is the force acting on the working roll during rolling, and the gauge S + T produces a rolling pressure force $\vec{p}_{(S+T)}$ of different direction and magnitude. The forces $\vec{p}_S$ and $\vec{p}_{(S+T)}$ can be resolved each into a vertical component $\vec{p}_{SV}$ or $\vec{p}_{(S+T)V}$ and a horizontal component $\vec{p}_{SH}$ or $\vec{p}_{(S+T)H}$. The roll 2 is displaced vertically and horizontally through variable distances by these forces. The vertical distances are denoted by l_{1PS} and $l_{1P(S+T)}$. The roll 2' is similarly displaced. The centres of rotation of the rolls 2 and 2' therefore change their position constantly and irregularly when roll stock of non-uniform gauge is being rolled, so that the gauge S_E of the strip 4 running out of the rolling mill fluctuates irregularly. The tolerance limit is defined by the bearing play, and also by roll deflection but only where the working rolls have a small diameter.

In order to avoid the transfer of the gauge fluctuations of the starting material to the final material there are provided initial stressing devices which act on outwardly-extended roll journals 8, 8'. The initial stressing devices comprise hydraulic cylinders 10' for the lower roll 2', mounted on frame uprights 9 of the rolling mill, and hydraulic cylinders 10 for the upper roll 2 mounted on adjusting equipment 13 of the upper roll, rams 11, 11' associated with the hydraulic cylinders 10, 10' running into bearing boxes 12, 12' which surround the roll journals 8, 8'.

The direction of thrust of the rams forms with the vertical lines a rolling angle α i.e. the angle between the direction of the force $\vec{p}_S$ acting on the working roll during rolling and the vertical direction, – represented exaggerated in Fig. 3. In the illustrated embodiment the hydraulic cylinders cannot deviate, but can do so in other embodiments.

The rolling angle α, by which the direction of thrust of the rams is inclined to the vertical, results in accordance with Fig. 5 from the reduction in gauge $S-S_E$ of the rolled stock and the diameter D of the rolls in $\cos\alpha = 1 - \frac{S-S_E}{D}$. The ratio $\frac{S-S_E}{D}$ in plants for equalising rolling mills is typically from about $\frac{1}{100}$ or therebelow. The associated rolling angle α amounts to about 8 degrees or less. It is, therefore, adequate for many applications to apply initial stress vertically and mount the hydraulic cylinders fixedly and incapable of deviation.

WHAT I CLAIM IS:–

1. An equalising rolling mill in which roll journals are prestressed in a plane normal to the roll axis and in a direction directed on to the roll-gap, which direction deviates from the vertical by the rolling angle, i.e., the angle between the direction of the force acting on the working roll during rolling and the vertical direction.

2. An equalising rolling mill, as claimed in Claim 1, in which the roll journals are extended outwardly beyond the roll journal bearings.

3. An equalising rolling mill, as claimed in Claim 1 or 2, in which the roll journals are hydraulically prestressed.

4. An equalising rolling mill substantially as hereinbefore described with reference to the accompanying drawings.

(FITZPATRICKS)
Chartered Patent Agents,
14/18 Cadogan Street,
Glasgow
– and –
Warwick House,
Warwick Court,
London WC1R 5DJ.

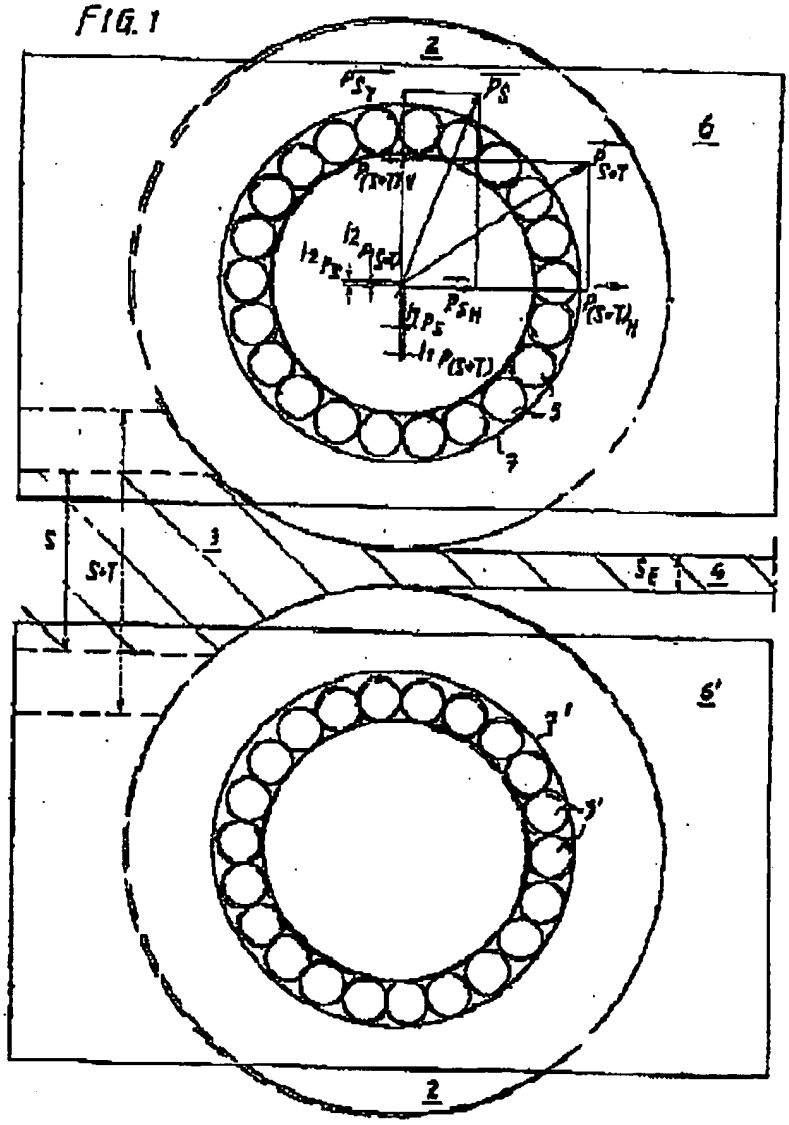
Printed for Her Majesty's Stationery Office, by Croydon Printing Company Limited, Croydon, Surrey, 1978.
Published by the Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.

1543621 COMPLETE SPECIFICATION

4 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 1

FIG. 1



1543621 COMPLETE SPECIFICATION

4 SHEETS *This drawing is a reproduction of the Original on a reduced scale*

Sheet 2

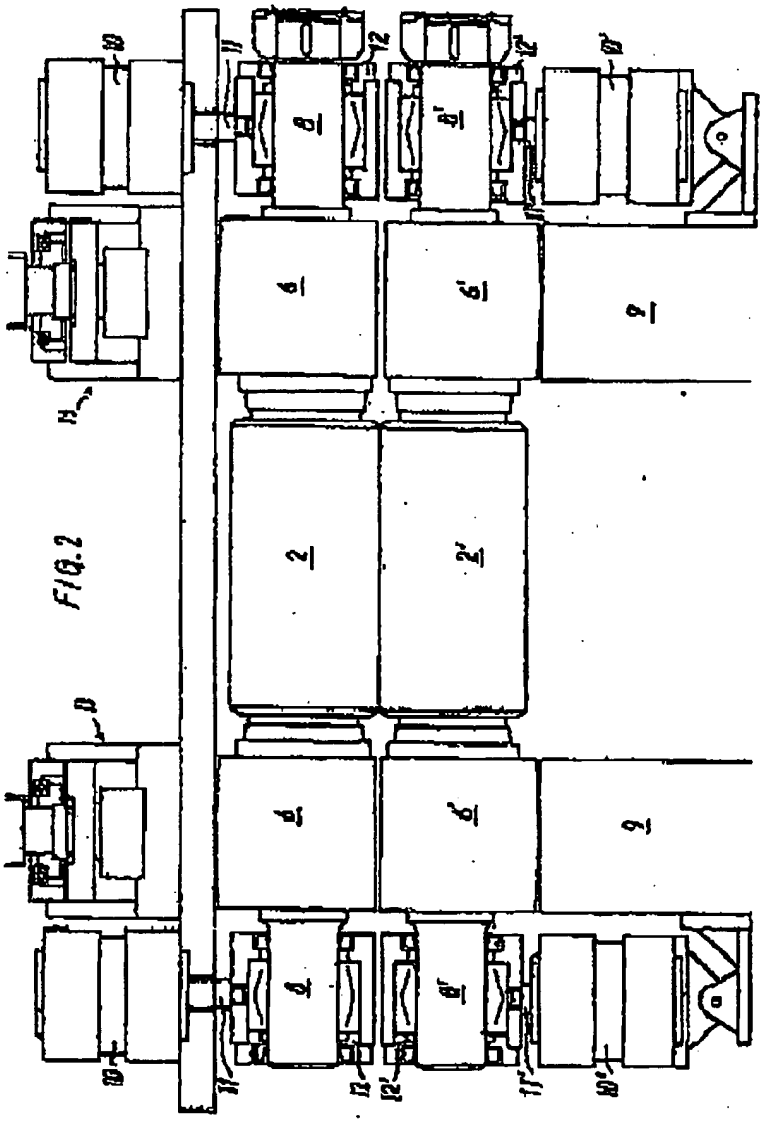


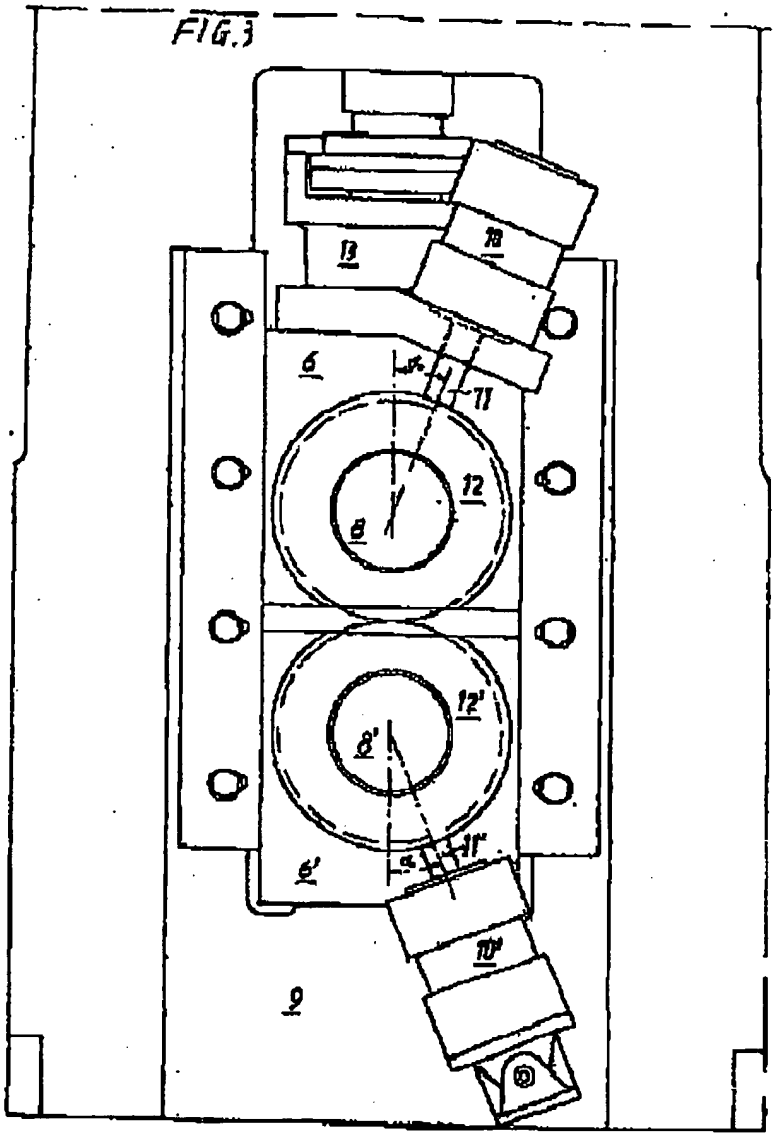
FIG.2

1543521 COMPLETE SPECIFICATION

4 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 3

FIG.3

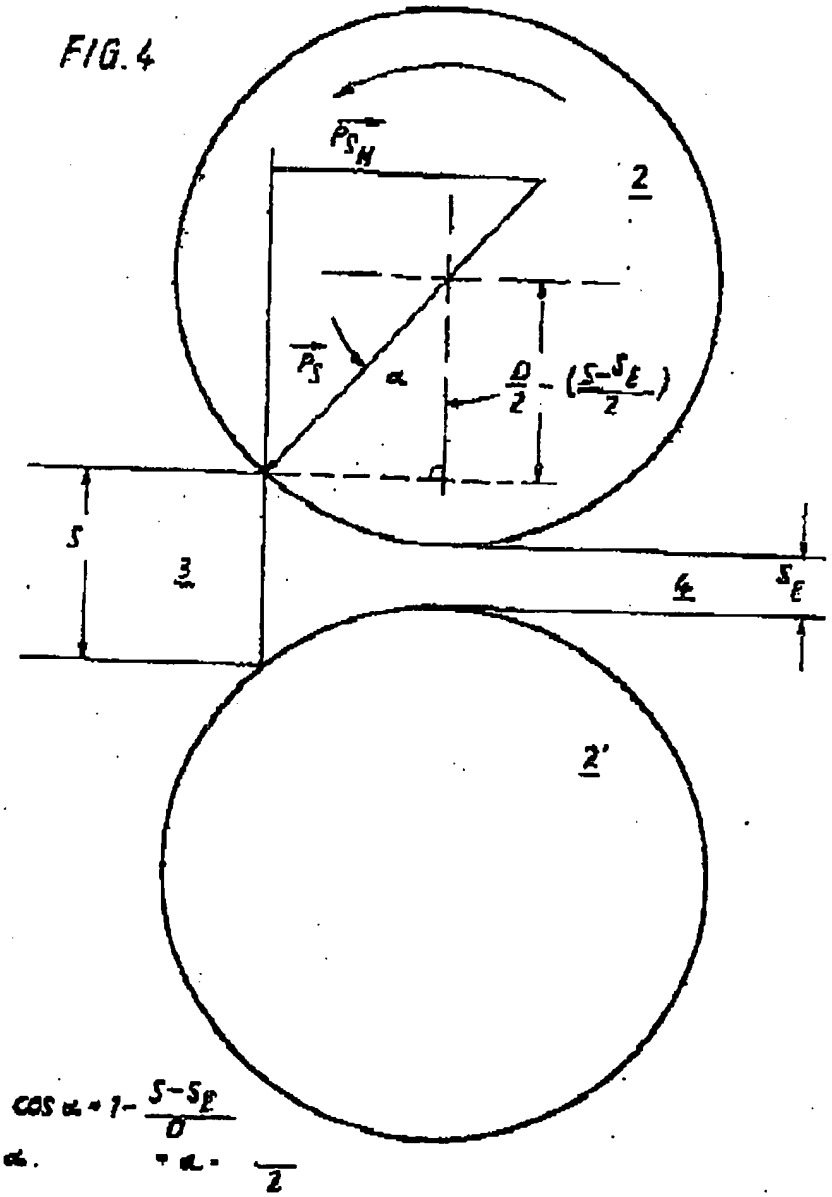


1543821 COMPLETE SPECIFICATION

4 SHEETS This drawing is a reproduction of the Original on a reduced scale

Sheet 4

FIG. 4



$\cos \alpha = 1 - \frac{S-S_E}{D}$

$\alpha_1 = \alpha - \frac{\alpha}{2}$